

ANNUAL HISTORICAL SUMMARY  
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UNITED STATES ARMY  
SATELLITE COMMUNICATIONS AGENCY

1 July 1971 - 30 June 1972

HL SPACE II (33)

## BACKGROUND

The US Army Satellite Communications (SATCOM) Agency, as Army Project Manager for satellite communications, is responsible for providing the ground environment for the Department of Defense Satellite Communications System. The SATCOM Project Manager also acts as the Army's agent for all international military satellite communications systems such as UK "Skynet" and the NATO system, and represents the Army in special DOD non-communications satellite projects. In addition, the SATCOM PM exercises complete life cycle management and support for the tri-service military satellite communications ground environment.

The Agency is an integrated facility performing satellite communications system engineering, research and development, testing and evaluation, and support functions for the DA under HQ, AMC. From its headquarters at Fort Monmouth, N.J. the Agency also directs the operations of a CONARC field unit while in garrison at Lakehurst (N.J.) Naval Air Station. This unit and the training area are used in testing and demonstrating tactical satellite communications equipment.

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Major advances in Phase II of the Defense Satellite Communications Program and in the development of small tactical satellite communications terminals marked Fiscal Year 1972 at the Army Satellite Communications Agency.

### Strategic Systems

The first of the new terminals, the Heavy Transportable (HT) AN/MSC-60, for the second phase of the Defense Satellite Communications System will be completed in 1972. This terminal has redundant critical components with automatic fault location and automatic switchover to increase operational availability and to permit reduction of operator skill levels. Steps have been taken in the design to minimize the effects of electromagnetic pulse interference. The AN/MSC-60 is scheduled for its reliability test of 1250 hours in September 1972 and will go into operational use thereafter.

The fabrication of the Medium Transportable (MT) terminals, the AN/MSC-61, is 80% complete and is scheduled to undergo environmental tests at the Eglin Air Force Base chambers early in FY 73. The AN/MSC-61 is electrically the same as the AN/MSC-60 with the exception of the transmitter and the antenna. The AN/MSC-60 has two three Kw and one 8 Kw transmitter and a 60 ft parabola antenna while the AN/MSC-61 utilizes an 18 foot antenna with two three Kw transmitters.

The technical specifications and contract negotiations were completed for a contract to be awarded for the construction of two terminals at Fort Detrick,



Maryland to provide a satellite trunk to replace the existing "Hot Line" between Washington, DC and Moscow, USSR. This program called the Direct Communications Link (DCL) will utilize Molniya II satellites on the West to East Link and Intelsat IV on the East to West Link. Final technical details are still being clarified by additional meetings between the two countries based on the original agreements which resulted from discussions at the early SALT talks.

Testing is underway at Philco-Ford on the acceptance of 15 Contingency Communication Subsystems, 8 Nodal Communication Subsystems and 7 Non-Nodal Communication Subsystems. These subsystem are the modulation portion of a satellite earth terminal and will interface with users of conventional military systems, either directly or through a Defense Communication System Technical Facility in the second phase of the Defense Satellite Communications System.

The contract of approximately 5.6 million dollars calls for the Contingency subsystem to interface with the AN/TSC-54 and provide 12 voice channels or 11 voice and 16 teletype. The interface is at 70 megahertz. The nodal system provides the necessary modem and multiplex equipment to support up to 7 satellite communications links simultaneously to non-nodal terminals through a single satellite repeater. The maximum total voice channels that a nodal can handle is 72. The non-nodal subsystem consists of a kit for the modification and upgrading of the Armadillo multiplex shelter and Operation Control Van portion of the AN/MS-46 earth terminal. The non-nodal system provides a 12 channel voice capability expandable to 24 channels.

Specifications were prepared and a contract is being negotiated for the fabrication of 6 Engineering Development models of the AN/USC-28, an advanced spread spectrum modulation-demodulation communication equipment for use in the earth terminals for increased anti-jamming protection with the DSCS second phase high power satellites. The anticipated contract will be sole source to Magnavox Research Laboratories. These EDM models shall be functionally configured as either Control and Synchronization Master (CSM) or a Control and Synchronization Slave (CSS) with up to 15 Communication Receiver/Transmitters being added as applique units. The CSM will be capable of broadcasting time reference and frequency corrections to the CSS terminals; broadcasting and receiving an anti-jam TTY Critical Control Circuit (CCC); and providing time and frequency corrections for up to 15 collocated Communication Receiver/Transmitter units and collocated Time Division Multiple Access (TDMA) equipment. The CSS will monitor the CSM broadcast transmission to extract the CCC and time and frequency information, slave its reference clock to that of the CSM, provide the appropriate time and frequency corrected signals to up to 15 collocated Communication Receiver/Transmitters (Comm R/T's) and collocated TDMA equipment. The Comm R/T is an applique unit that can be added to either a CSM or CSS. It can provide either a full duplex, Link Order Wire (LOW) as the only mode or a LOW plus a digital data channel. The LOW operates at 75 bps and the digital data channel can operate from 75 bps to 5 Mbps uncoded and 75 bps to 2.5 Mbps when an external coder/decoder is utilized.

A wide band secure circuit, code name Muscle Trunk, has been established utilizing satellite communications for operational traffic between Washington, DC and Hawaii. The trunk interconnects the 758C secure switch in the Pentagon and the AN/FTC-31 switch located at Pearl Harbor. This circuit allows subscribers in the Washington area to call on a wide band secure circuit and other subscriber located in Hawaii. The trunk provides two secure and two clear voice channels. The data rate is 225 Kbits with an error rate of  $10^{-5}$ . The Muscle Trunk circuit was recently extended from Hawaii to Vietnam, on an operational basis. This allows operational wide band secure traffic from Hawaii to Vietnam and the Pentagon to Vietnam.

An advance development model of a hard or soft decision maximum likelihood decoder was developed for use in the Defense Satellite Communications System. The decoder will operate to 2 Mbits with E/No of 5.5 at an error rate of  $10^{-5}$ . Based on the performance of this advance development model, specifications were written and a solicitation was made for the development of Engineering Development Models of a 2 Mbits and a 7 Mbits maximum likelihood decoder. A contract is expected with Linkabit Corp., San Diego, California.

A contract was awarded to Radiation, Inc., Melbourne, Florida for the development of Phase Shift Keying (PSK) Modem and an Interconnect Facility (ICF) Modem. These modems will operate at any data rate up to 10 MB/s and will interface with the decoders. These modems will be utilized in Stage 1B and 1C of the second phase of the DSCS to transmit digital traffic.



General Atronics, a division of Magnavox was awarded a contract to develop analog to digital (A/D) and digital to analog (D/A) converters. These converters will be capable of detecting whether analog or digital information is being transmitted over the line. If it is analog, then the A/D converters will digitize the analog data into 50 KB/s. These data will then be multiplexed and transmitted over the satellite link. On the receiving end the digital traffic will be converted to analog by the D/A converters. These equipments will be used with Muscle Trunk circuits.

Radiation Incorporated was awarded a contract for the development of an experimental model solid state terminal. This terminal will utilize microwave integrated components (MIC) to obtain up converters, down converters, filters, intermediate RF amplifiers, frequency synthesizers, and low noise receivers. This equipment will be small in size and low in power consumption. Initial tests will be made with the terminal equipment driving a phase array. The subsystem can be used with an antenna with filter changes.

In support of the DSCS Phase II Program the SATCOM Agency undertook the procurement of equipment and the development of software for monitoring and controlling communications links over Phase II satellites.

The first of a series of Spectrum Analyzers was delivered in December 1971 and instructions for its use as a manual system monitor were developed and tested. In May 1972, the manual analyzer with monitoring and computational procedures was deployed to Hawaii to support DCA Pacific personnel in monitoring Satellite 9431.

The first DSCS Automated Satellite Spectrum Monitor was delivered in November 1971. Software for satellite monitoring processes and system power computations was developed and in June, an operational system was deployed to Hawaii.

Written procedures covering terminal operation, monitor facility operation, computational procedures, and other documentation were prepared for DCA and are included in Draft DCA Circular 831-70 which was published in May 1972.

Satellite Evaluation Network (SEN) test procedures for Stage 1a and the test plan for Stage 1b were completed. An extensive Stage 1a test program was conducted on Phase II DSCS Satellites 9431 and 9432 utilizing AN/TSC-54, AN/MSC-46, and AN/FSC-9 terminals located at Fort Monmouth, NJ ; Fort Dix, NJ; Brandywine, MD; Fort Huachuca, AZ; and Heleman, HI. Satellite and terminal characterization information obtained during this test program will permit more efficient utilization of satellite and terminal capabilities.

Communications system tests were performed on the Interim Contingency Communications Subsystem (ICCSS) over a Phase II Satellite link between Brandywine, Maryland, and Fort Huachuca, Arizona. The ICCSS upgrades the AN/TSC-54 to provide a twelve voice channel capability and was designed and fabricated in house to meet the initial launch of the Phase II satellites. All logistics and provisioning items, spare parts, technical manuals and programs of instruction for these equipments were prepared in house.

Under a contract to Hughes Aircraft Company, a Group Delay Test Set was designed and developed. It provides a means of measuring group delay at 70 MHz and 700 MHz IF to satisfy Phase II test requirements. Measurements



were successfully conducted on a Phase II satellite.

Communications Support for USAF SCF was provided by designing and constructing in house modifications to provide certain AN/MSC-46 link terminals with the capability to simultaneously transmit two RF carriers and the AN/FSC-9 at Camp Roberts with two additional down converters for their reception. Called Project SHAG, each modified AN/MSC-46 will provide one carrier in the Earth Coverage to Earth Coverage satellite band and a second carrier in either the same band or the Earth Coverage to Narrow Beam band. This configuration will permit the modified terminals to continue their normally scheduled communication activity at the same time the accommodation is provided to the special users. In order to minimize the impact on logistics support and training maximum use was made of parts and circuits identical to those used in the original link terminal.

The Agency participated in site surveys in Lago De Patria and Bagnoli near Naples, Italy to prepare for a US Navy satellite communications link.

Technical assistance was provided to US Army Strategic Communications Command in the relocation of an AN/MSC-46 Satellite Communications Earth Terminal from Wildwood, Alaska to Taegu, Korea.

Technical Assistance was supplied by in house engineers and technicians to the tri-service operated terminals for the Defense Communications Satellite System as follows:

AN/MS-46

<u>Terminal</u> <u>S/N, Call, Location</u>	<u>Dates</u>	<u>Reason</u>
9 OFUT Okinawa	1-8 Jul 71	URC-55 & Link Checkout
3 PCAB Philippines	9-13 Jul 71	URC-55 & Link Checkout
3 PCAB Philippines	23-27 Jul 71	Paramp & Track Receiver
11 HHON Hawaii	9-12 Sep 71	Interim WB Paramp
14 AWLD Wildwood, Alaska	19 Sep-6 Oct 71	Preparation for redeployment to Taegu, Korea
5 AMAR Asmara	10-26 Nov 71	RFI - RF leakage
13 GDON Landstuhl	18-21 Nov 71	Interim WB Paramp
7 VSAI Saigon, VTN	4-11 Dec 71	URC-55
5 AMAR Asmara	7-16 Dec 71	Dielguide replacement
3 PCAB Philippines	15-21 Dec 71	Transmission
14 KTAG Taegu, Korea	31 Jan-15 Mar	Installation
1 TDYR Turkey	2 Feb-7 Mar 72	System Checkout & Alignment
9 OFUT Okinawa	16 Feb-3 Mar	URC-55
3 PCAB Philippines	18 Mar-10 Apr	Rehabilitation
12 MBWE Brandywine, MD	11-12 Apr 72	Phase II Track Receiver Mod
5 AMAR Asmara	22 Apr-2 May	Inspection & evaluation
3 PCAB Philippines	25 Apr-1 May	Transmission-Az drive
7 VSAI Saigon VTN	10-24 Jun 72	Transmission-Az drive

AN/TSC-54

3 OTAF Tinker AFB	16-17 Jul 71	Courier servo amplifier
8 GTMO Guantanamo Bay	3-6 Aug 71	Servo system parts & wiring
12 MAND Brandywine, MD	3 Sep 71	Courier paramp
8 GTMO Cuba	21-24 Sep 71	OPEVAL
9 KSAN Seoul, Korea	8-10 Oct 71	Courier paramp & OJT
5 ACAP Harold E. Holt	13-16 Oct 71	Courier paramp & OJT
12 MAND Brandywine, MD	22-23 Oct 71	Courier paramp
12 MAND Brandywine, MD	27-28 Oct 71	Courier paramp
1 ACHU Ft Huachuca, AZ	4-6 Nov 71	Paramp
8 GTMO Cuba	16-19 Nov 71	Paramp
10 VNOR NW Va	6-10 Dec 71	Antenna Dish Crack Repairs
10 VNOR NW Va	18 Feb 72	Paramp
9 KSAN Seoul, Korea	11-20 Mar 72	Tracking problem
10 VNOR NW Va	10-12 Apr 72	OPEVAL
3 OTAF Tinker AFB	9-11 May 72	Inspection
1 ACHU Fort Huachuca, AZ	13-17 May 72	Servo problem
6 CADC Lamar, Colo	31 May 72	Certification of Serviceability

### Tactical Systems

The two Army AN/TSC-80 shelter mounted TACSAT terminals have been modified to permit operation with the Phase II satellites in the NC-NC mode in a multichannel configuration. The modification consists of a frequency conversion of the transmitting and receiving subsystems which provide four frequencies of operation in addition to NC Beacon Signal reception.

The common modem and its accessories were removed, and a Pulse Code Modulation (PCM) 12 channel multiplexer, TD-660, a 12 channel echo suppressor and a 12 channel ring converter, CV-1548, were installed in its place. These items were interfaced with the DPSK modems which were procured with the Army's AN/TSC-80. The Differential Pulse Shift Key (DPSK) modem was converted from 6 channel (288 Kbit) to 12 channel (576 Kbit) operation. The modified terminals were operationally tested with Phase II Satellite 9432 in June 1972.

In response to a request by AFSCF, the tactical terminal AN/TRR-30 alert receiver was modified to provide a 24 hr/day monitor for Phase II Satellites 9431 and 9432.

The modification consists of the design and installation of a mixer oscillator to permit reception of the Phase II Satellite Beacon signals and the addition of a second tunnel diode amplifier to improve the receiver sensitivity by decreasing its effective noise temperature.

The modified receivers were tested and demonstrated at the SATCOM Agency and then delivered to Camp Parks, CA to serve as around the clock monitor terminals.



Specifications and procurement documents were prepared and technical bid evaluation completed to select a contractor for the second generation Tactical Satellite Communication ground terminals. These engineering development models will consist of four 1/4 ton, three 1 1/4 ton and two 2 1/2 ton terminals. The 2 1/2 ton terminals are the so-called Light Terminals (LT) for the DSCS.

Under the code word Dutch Oven the Agency prepared specifications and procurement documents for man transportable specially packaged terminals. Proposal evaluations have been completed and a contractor will be selected for these 4 terminals which will be provided for a special user. Award is expected during the first quarter of FY 73.

The Agency developed a Minimum Usable Satellite (MUSAT) terminal and applique unit to be used with the UHF 1 1/4 ton and 1/4 ton vehicular mounted terminals. A test program was conducted at various locations at low and high look angles to determine the capabilities and limitations of this terminal.

The UHF Airborne Terminal (AN/ARC-146) was reconfigured and palletized, providing an additional terminal asset of flexible configuration for the 235th Signal Detachment.

Tactical ground terminals designed in conjunction with the other services or developed by the Army have been used under varied environmental conditions and in simulated tactical situations. During fiscal year 1972 the following major exercises have received TACSATCOM Support:

<u>Exercise</u>	<u>Dates</u>
ALoud LIMA	4 - 10 Dec 71
Presidential Support/Azores	2 - 15 Dec 71
ACE CARD IV	3 - 13 Mar 72
ACE BAND POLAR CAP II	18 - 31 Mar 72
GALLANT HAND 72	23 - 31 Mar 72
ALoud MIKE	8 - 14 Apr 72
CONARC Demo	24 - 26 Apr 72
CSPR III	11 - 12 May 72
EXOTIC DANCER	13 - 25 May 72
GOLDEN STEP 72	12 - 26 Jun 72

Below is a brief description of the TACSATCOM support provided for each of these exercises:

a. Two UHF 1/4 ton terminals were deployed, one to Fort Bragg and the other to Fort Meade, in support of the 18th Corps and JFK Center respectively for Signal Exercise ALoud LIMA. Both terminals arrived on site on 4 December with 4-day exercise beginning on 6 December. A voice command circuit was established between the 414th Signal Support Company (Fort Meade) and the 35th Signal Group (Fort Bragg) and held for the duration of the exercise. Due to Lincoln Experimental Satellite (LES-6) commitments to the White House Communications Agency (WHCA) one channel was designated for all ALoud LIMA traffic and was shared by the Air Force, Marines, Navy, and Army participating terminals, with

the Navy serving as net control. Circuit traffic was heavy throughout the exercise.

b. On 2 December, the CET (Communications Electronic Team of the 235th Sig Det) was notified of a presidential support requirement from the Azores. The CET arrived in Washington on 2 December and departed with WHCA elements for the Azores on 4 December. Once positioned, a full duplex, non-secure voice link was established between the CET and the Andrews Air Force Base tactical terminal, with an output power of 110 watts. A backup circuit using the WHCA terminal and the Tactical Relay Operations Center (TROC) was available but was never required.

Both White House staff and press personnel used the circuit extensively. President Nixon used the circuit twice with favorable comment. Team members involved received individual certificates of appreciation signed by the President.

The CET was returned to Lakehurst on 15 December with favorable comment from using personnel and from WHCA.

c. On 3 March, TACSATCOM terminals commenced support of the USARAL ACE CARD IV Exercise. One UHF 1/4 ton terminal was located at Fort Wainwright, with HQ 171st Inf. Brigade and another UHF 1/4 ton terminal was positioned at Fort Richardson for direct contact with HQ USARAL. A UHF Teampack terminal was deployed to Galena with elements of the 171st. The TACSATCOM terminals provided the primary voice command control communications link from maneuver elements to unit Headquarters. The exercise was successfully completed on 13 March.

d. Deployment for participation in another USARAL Exercise, ACE BAND POLAR CAP II, on 18 March, again placed the 1/4 ton terminals at Fort Wainwright



g. On 24 April, one of each type of UHF terminal departed Lakehurst for Fort Monroe to demonstrate TACSATCOM to HQ CONARC and to an AFCEA Luncheon on 26 April. This was the first time CONARC HQ had seen the terminals since they became CONARC assets in December 1971. Demonstrations were held throughout the day of the 26th and were very successful. All terminals returned to Lakehurst on 27 April.

h. A TACSATCOM Demonstration for the Third Communications Systems Program Review (CSPR III) was held on 11 and 12 May. The demonstration was presented twice and was attended by 28 General Officers, including VCSA General Palmer. The presentation consisted of the arrival of a UHF Team Pack on site by helicopter, the actual set up of that Team Pack, and the demonstration of the Team Pack's various interface and communications capabilities. The demonstration was successful, and comments on it were extremely favorable.

i. On 13 May, all UHF assets (2 Team Packs, 2 1/4 ton, and 1 5/4 ton terminals) were deployed to Fort Bragg/Camp Le Jeune, N.C. for exercise EXOTIC DANCER. The 5/4 ton terminal was used as the Land Forces Station in the Joint (Army-Navy-Air Force-Marine) Voice Command net. One of the two 1/4 ton terminals was deployed with 18th Corps Headquarters, and the remaining three were deployed with the 82d Div to form Corps-Division Voice Command net. Exercise was terminated on 25 May and experienced limited success as LES-6 time was often preempted for WHCA Priority 1 requirements.

j. On 12 June, one UHF 1/4 ton and one UHF teampack were deployed to Germany to support exercise GOLDEN STEP. The teampack was redeployed to Aviano, Italy, to support airborne maneuver elements under HQ EUCOM while the

and Fort Richardson while the teampack was deployed to Point Barrow with the 75th Arctic Rangers. On 23 March, the teampack was repositioned onto the arctic ice, 250 miles northwest of Point Barrow while Ranger elements jumped onto the Ice Cap site. The terminals were used to form the Exercise voice command net and during periods when personnel were deployed on the Ice Cap, were the sole means of communication back to the Command and base support elements. Upon successful completion of the exercise, the TACSATCOM terminals departed Alaska on 31 March for Lakehurst.

e. On 23 March, one UHF Teampack and one UHF 1 1/4 ton terminal were deployed to Fort Hood for FTX GALLANT HAND in support of the 2d Armored Div. Both terminals were deployed to the field on 25 March, the 1 1/4 ton with Div HQ and the teampack with various maneuver brigades. In each case the terminals were used to provide voice command control communications. Results of the exercise were successful with the teampack performing extremely well under the highly mobile field conditions imposed. Both terminals were redeployed to Lakehurst on 31 March.

f. On 8 April, one UHF 1 1/4 ton terminal was deployed to Camp LeJeune for Signal Exercise ALOUD MIKE. The terminal supported 18th Corps IIQ by providing the land forces (18th Corps) terminal in the joint voice command net, circuit 21. ALOUD MIKE was designed to test the communications plan for the upcoming exercise EXOTIC DANCER V and involved Air Force, Army, Navy and Marine Forces. The exercise was successfully completed on 14 April and the terminal was returned to Lakehurst.

1/4 ton terminal remained at Patch Barracks, Stuttgart, with HQ VII Corps.

The terminals provided a voice command link from VII Corps to HQ EUCOM for the duration of the 14 day exercise. Support for the exercise was successful with no terminal outage reported.

#### Navigation System

As coproponents, the USA Combat Development Command Intelligence Agency, acting for USACDC, and USASATCOMA, acting for USAMC, prepared the "Draft Proposed Materiel Need for Army User Equipment for use with the Defense Navigation Satellite System (DPMN-AUE/DNSS)" and the "Draft Proposed Materiel Need Technical Plan for Army User Equipment for the Defense Navigation Satellite System (DPMNTP-AUE/DNSS)".

The DPMN-AUE/DNSS establishes requirements for three basic applications: manpack, land and sea vehicles, and airborne. There are requirements for four special applications: Field Artillery and Engineering Survey, Geodetic, SIGINT, and Target Acquisition.

SAMSO/USAF has established, at the White Sands Missile Range, a navigation satellite simulation facility to verify the theoretical performance of several of the System 621B concepts. This facility places the satellite transmitters on the ground in a geometric configuration typical of proposed space system. The aircraft looks "down" at the signal source instead of "up" as would be the condition with satellites.

SAMSO/USAF has been testing four-channel receivers in high-dynamic aircraft. AFAL has contracted for a test of single-channel receivers integrated with



inerial platforms in high-dynamic receivers. As a logical extension of these tests, USASATCOMA has arranged for a contract with TRW, Inc. to design hardware and test the single-channel receivers alone and with low-cost self-contained positioning systems in low-dynamic aircraft.

Because DNSS has the potential of meeting the positioning, navigation, survey and velocity data for so many diverse applications, agreements were reached between USASATCOMA and several developer organizations to provide technical support to Army Project Manager for DNSS. The USA Engineering Topographic Laboratories will provide support for the application of DNSS to survey requirements; the USAECOM Electronic Warfare Laboratory for SIGINT applications; the USAECOM Combat Surveillance and Target Acquisition Laboratory for applications to STANO; the USAECOM Avionics Laboratory for airborne applications and hybrid systems; USAMUCOM and USAWECOM, through Frankford Arsenal, for the application to fire control systems; and USAECOM PM/NAVCON for the integration of DNSS into the common Army Positioning and Navigation Systems (PANS).

#### Conclusion

As the Agency for engineering satellite communications ground terminals and related systems, SATCOM is constantly advancing the design of terminals for use in strategic and tactical military networks. New concepts and techniques are being evolved through an intensive program of research and development towards the goal of reliable communications for the Armed Forces of the United States wherever they may be deployed.